Long range straightness using the XK20 alignment laser system

Introduction

Laser measurement in an environment of still air at uniform temperature provides the best results. However, in industrial environments achieving this is not practical. Sources such as air conditioning, heaters, motors producing heat, and open doorways can lead to air turbulence along the measurement path. Air turbulence is caused by moving pockets of warm and cold air passing through the measurement path. This causes angular deviation of the laser beam resulting in positional errors that do not represent the true axis error.

Long range straightness in the CARTO XK20 app uses a test method which helps reduce the effects of air turbulence by recognising when data is outside a user-specified repeatability value. The software breaks the measurement into sub tests. On completion of all sub tests, the data is stitched together to provide a single measurement for the entire axis length.

Before using the long range straightness mode, there are some considerations to be aware of to help reduce the effects of air turbulence in the measurement.

Identifying air turbulence

When measuring straightness data over longer distance, there can be noticeable amounts of instability in the laser reading.

- Slow 'wandering' of the laser reading is likely to be an effect of air turbulence in the measurement path.
- High-frequency 'flickering' of the laser beam reading is likely to be a result of mechanical vibration.

Measurement considerations

Preparation is an important part of the measurement process to gain quality results.

Reduce sources of air turbulence
Minimise air turbulence by switching off air conditioning, heating and closing open doors. This helps to eliminate the warm and cold pockets of air from the laser beam path, resulting in better stability of laser readings.

Filtering
Filtering can improve the precision of the data captured. The XK20 CARTO app uses a median averaging filter to exclude anomalies within the data sample. However, this will not completely overcome the effects of air turbulence. The filtering options available are:

Filtering level	Sample period
Off	0 seconds
Low	2 seconds
Medium	6 seconds
High	10 seconds

Key software terms

The software requires some additional parameters:

Repeatability tolerance

The difference between two error readings at the same target position.

The value is user-defined. The software reports a start position for a sub test when the data is out of tolerance.

Overlap

The target positions to be repeated for the software to stitch the data together.

The default value in the software is four. However, the range is from three up to nine depending on the accuracy required.

When should I use long range straightness mode?

Accuracy requirements and environmental stability must be considered for any measurement, especially over long axes, as repeatability typically decreases with distance. However in particularly unstable environments, results may be unrepeatable along axes as short as 2 metres.

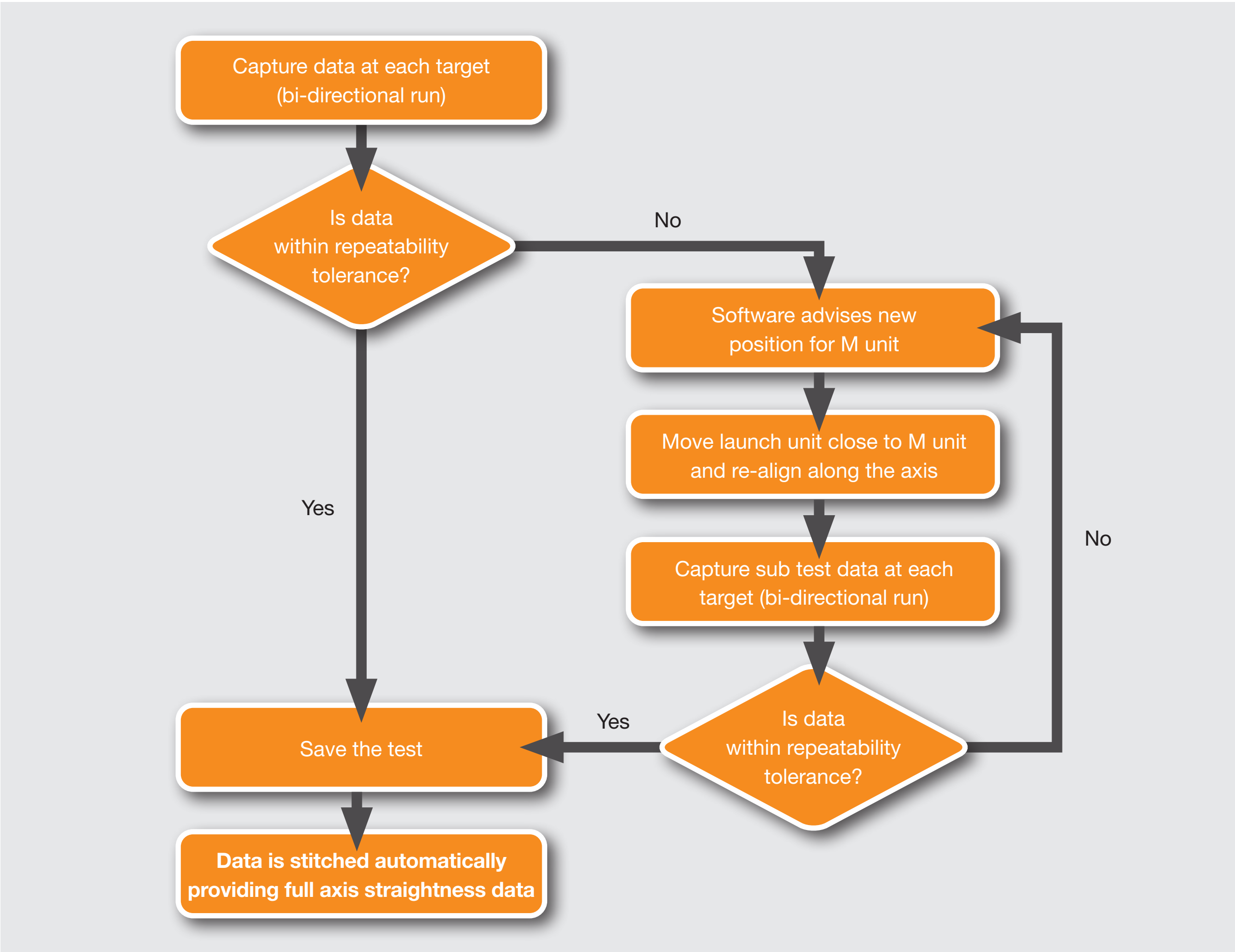
Assessing the repeatability of the results will determine the measurement approach required. Long range straightness helps verify measurements and increases confidence in the results.

The table below provides guidance for common application scenarios.

Distance	Capture method
Up to 2 metres	Short range straightness mode
2 metres to 4 metres	Consider using filtering in short range straightness
4 metres to 40 metres	Use long range straightness mode

For guidance only.

Measurement process



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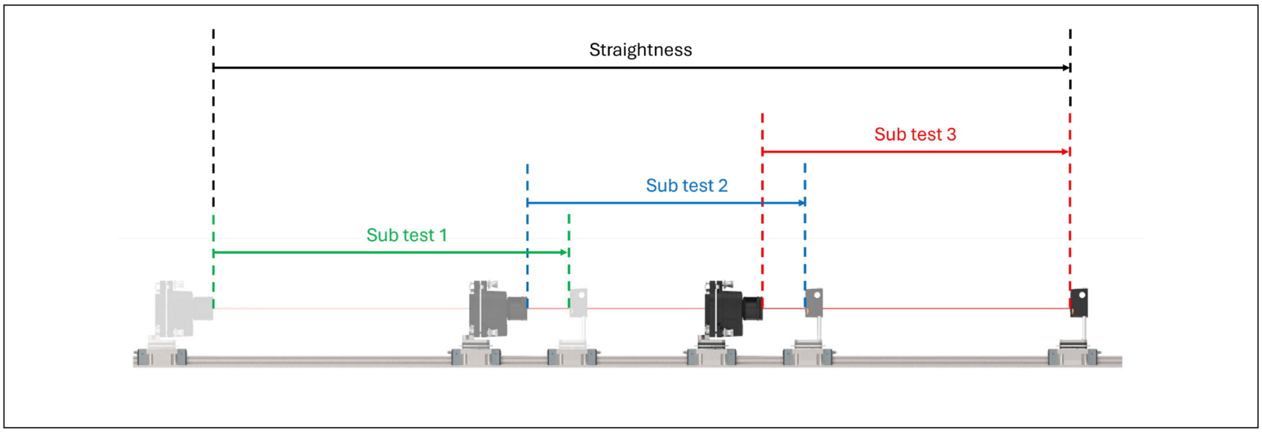
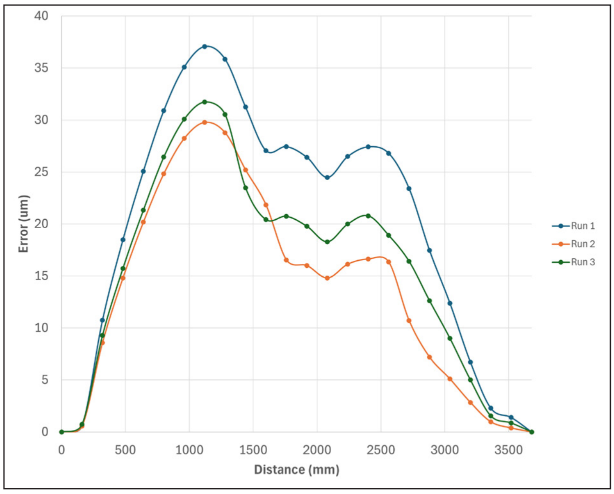


Example of long range straightness test

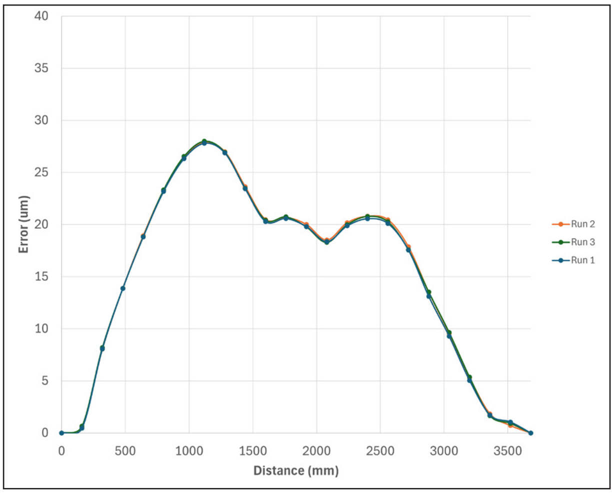
Example

The data plots demonstrate straightness data capture of a 3,600 mm axis in an environment affected by air turbulence.



The graph above shows three separate runs of a 3,600 mm rail in an environment with air turbulence.

The differences between the three data sets show that the runs are not repeatable.



The graph above shows three separate runs on the same rail in the same environmental conditions.

This data is captured using long range straightness mode with two ‘stitch’ areas of four overlapping target positions.

Summary

Air turbulence can significantly impact the accuracy and repeatability of straightness measurements – particularly over longer distances. Minimising sources of air turbulence where possible is important prior to measurement.

Long-range straightness within the CARTO XK20 app can identify areas of air turbulence, recommend optimal stitch points, and reduce its effects. This approach delivers greater accuracy and repeatability compared to traditional long range measurement techniques.

Long range straightness may increase measurement time, it greatly enhances confidence in the results. The XK20 alignment laser is capable of delivering consistent, repeatable measurements in industrial environments.

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